

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

REC'D 08 DEC 2004

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Applicant's or agent's file reference SUVN-RK-004	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/IN 03/0223	International filing date (day/month/year) 19.06.2003	Priority date (day/month/year) 21.06.2002
International Patent Classification (IPC) or both national classification and IPC C07D487/04		
Applicant SUVEN LIFE SCIENCES LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
  - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 43 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  19.01.2004	Date of completion of this report  04.10.2004
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Boletti-Cremers, K  Telephone No. +49 89 2399-8541  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/IN 03/00223**

**I. Basis of the report**

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*

**Description, Pages**

4, 15, 17, 18 as originally filed  
16 received on 24.05.2004 with letter of 22.05.2004  
1-3, 5, 6, 6A, 7-12, 12A, 13, 14, received on 20.09.2004 with letter of 09.09.2004  
19, 20-37

**Claims, Numbers**

1-22 received on 20.09.2004 with letter of 09.09.2004

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/IN 03/00223**

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6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-22 , with proviso that an acceptable formulation of the claims could be provided in the regional proceedings to come.
	No: Claims	
Inventive step (IS)	Yes: Claims	1-22, with the same proviso as for the novelty .
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-22
	No: Claims	

2. Citations and explanations

**see separate sheet**

**Point I. - Lack of support and Clarity of the amendments.**

1.1 Although most of the claims on file are the result of a drastic restriction of the original claims, some amendments cannot find a clear and unambiguous support in the original application as filed.

Indeed as now on file the side chain located on the position 11 of the (I) compounds refers to a repeated motive where  $n$  can either be 1 or 2.

Although the original filed matter and all the examples refer unambiguously to a value of 1 for  $n$ , there is no support for the value of  $n$  being 2, which now contravenes the requirements of Art 34 (2) (b), last sentence PCT.

Either the value of  $n : 2$  should be deleted from the application, or the Applicant is invited to point out from the original application as filed and in the regional proceedings to come, where a possible, clear and unambiguous descriptive support exists for the value  $n : 2$ .

1.2 Previous point I of the preliminary opinion (see point I of 21.06.2004) is set aside in view of the reformulations and replaced by present point I.

**POINT V.**

The following documents, quoted in the I.S.R., have been considered as relevant for the examination of the present application. Their numbering will be adhered to for the rest of the procedure.

- (1) Bioorganic & Medical Chemistry Letters 2001, 11(9),1237-1240.
- (2) WO-A-0076521.
- (3) WO-A-9300334.
- (4) US-B1-6465660 (Point VI).

**1. Novelty.**

1.1 Since, according to the definitions of the claimed compounds, when  $n:1$  and both  $R_{11}$  and  $R_{12}$  are an oxo radical, the claimed compounds should be -amido-methylene substituted- and not amido ethylene as in (1), and in view of the fact that, provided  $n: 2$  could be acceptable in the regional proceedings to come, the claimed compounds should be a radical -  $R_9 R_{10}-(C-R_{11}R_{12})_n-NR_{13} R_{14}$  of the type  $-CH_2-(CO-CO)-NR_{13} R_{14}$  (if  $R_9 R_{10}$  is methylene, of course), the claims on file are novel with respect to the content of (1). Moreover, since the compounds disclosed

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/IN 03/00223

in (3) are not isoindolones , but isoindoles compounds , the claimed matter can also be regarded as novel with respect to the content of (3).

1.2 In view of the fact that the compounds disclosed in (2) are not tetracyclic isoindolo(2,1-a)indolone compounds , the novelty of the claims with respect to the content of (2) is acknowledged.

1.3 Whether the content of (4) , as published on 15.10.2002, is relevant for the examination of the novelty and the inventive step of the claimed matter will only be investigated in the European regional phase and will essentially depend on the examination of validity of the priority rights claimed by present invention , which at present is not possible. Although (4) is not prior art according to the Chap II PCT proceedings, its content does not affect the novelty of the claims on file because it lacks the side chain located on position 11 of the isoindolo(2,1-a)indolone compound

**2. Inventiveness.**

Since there is no logical structure- activity relationship between the claimed compounds and those disclosed in (1) and (3), the claimed matter can be regarded as inventive with respect to the prior art.

**3. Formal Point .**

3.1 Documents (1) and (3) should be mentioned and briefly discussed in the description when the application will enter the regional proceedings to come.

the solvent of crystallization, inherent in the solvent preparation or crystallization, or adventitious to such solvent. Such solvates are within the scope of this invention.

The invention also encompasses the pharmaceutically acceptable prodrugs of the compounds of the formula (I). A prodrug is a drug which has been chemically modified and may be biologically in-active at the site of action, but which may be degraded or modified by one or more enzymatic or other in-vivo processes to the parent form. This prodrug should have a different pharmacokinetic profile than the parent, enabling easier absorption across the mucosal epithelium, better salt formation, or solubility, and/or improved systemic stability (an increase in the plasma half-life, for example). Typically, such chemical modifications include the following:

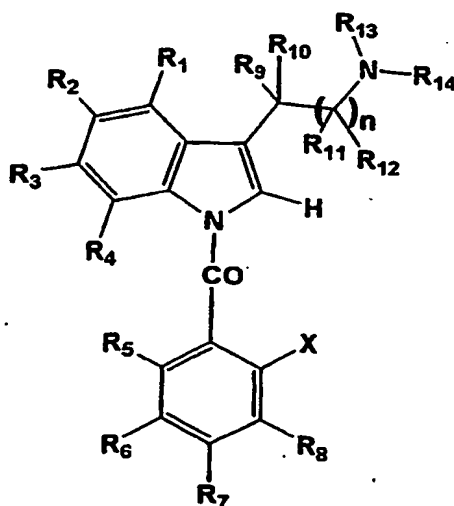
1. ester or amide derivatives which may be cleaved by esterases or lipases;
2. peptides which may be recognized by specific or non-specific proteases; or
3. derivatives that accumulate at a site of action through membrane selection of a prodrug from or a modified prodrug form; or any combination of 1 to 3, above.

Conventional procedures for the selection and preparation of suitable prodrug derivatives are described, for example, in H. Bundgard, Design of prodrugs, (1985).

Compounds of general formula (I) can be prepared by any of the methods described below. The present invention also provides processes for preparing compounds of general formula (I) as defined above, their derivatives, their analogs, their tautomeric forms, their stereoisomers, their geometric forms, their polymorphs, their pharmaceutically acceptable salts and their pharmaceutically acceptable solvates, novel intermediates described herein, where  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ ,  $R_8$ ,  $R_9$ ,  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{13}$ ,  $R_{14}$  and "n" are as defined previously can be prepared by any of the methods described below:

**Scheme - 1 :**

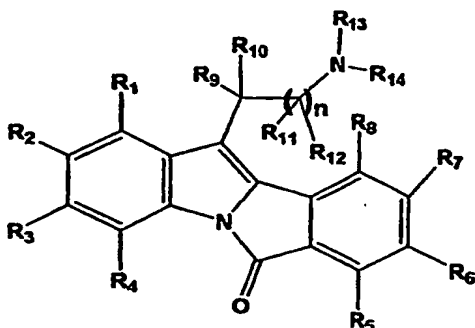
Compounds of general formula (I), may be prepared by cyclizing a novel-intermediate of formula (II) given below,



**Novel tetracyclic arylcarbonyl indoles having serotonin receptor affinity useful as therapeutic agents, process for their preparation and pharmaceutical compositions containing them**

**Field of Invention:**

5 The present invention relates to novel tetracyclic arylcarbonyl indoles, their tautomeric forms, their stereoisomers, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates, novel intermediates described herein and pharmaceutically acceptable compositions containing them.



**General formula (I)**

10 The present invention also relates to the process for preparing the compounds of general formula (I), their tautomeric forms, their stereoisomers, their geometric forms, their N-oxides, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates, novel intermediates described herein and pharmaceutically acceptable compositions containing them.

15 The compounds of the general formula (I) of this invention are 5-HT (Serotonin) ligands e.g. agonists or antagonists.

20 Thus, compounds of general formula (I) of this invention are useful for treating diseases wherein activity of 5-HT (Serotonin) is modulated to obtain the desired effect. Specifically, the compounds of this invention are useful in the treatment and / or prophylaxis of psychosis, paraphrenia, psychotic depression, mania, schizophrenia, schizophreniform disorders, anxiety, migraine headache, depression, drug addiction, convulsive disorders, personality disorders, hypertension, autism, post-traumatic stress syndrome, alcoholism, panic attacks, obsessive-compulsive disorders,

and sleep disorders.

The compounds of general formula (I) of this invention are also useful to treat psychotic, affective, vegetative and psychomotor symptoms of schizophrenia and the extrapyramidal motor side effects of other antipsychotic drugs.

5 The compounds of general formula (I) of this invention are also useful to treat neurodegenerative disorders like Alzheimer's disease, Parkinsonism and Huntington's chorea and chemotherapy-induced vomiting. The compounds of general formula (I) of this invention are also useful in modulation of eating behavior and thus are useful in reducing the morbidity and mortality associated with excess weight.

## 10 Background of the Invention

Many diseases of the central nervous system are influenced by the adrenergic, the dopaminergic and the serotonergic neurotransmitter systems. Serotonin has been implicated in a number of diseases and conditions, which originate in the central nervous system. These include diseases and conditions related to sleeping, eating, perceiving pain,  
15 controlling body temperature, controlling blood pressure, depression, anxiety, schizophrenia and other bodily states. (References: Fuller, R. W., Drugs Acting on Serotonergic Neuronal Systems, Biology of Serotonergic Transmission, John Wiley & Sons Ltd. (1982), 221-247; Boullin D. J., Serotonin in Mental abnormalities (1978), 1, 316; Barchas J. et. al., Serotonin and Behavior (1973)). Serotonin also plays an important role in the peripheral systems,  
20 such as the gastrointestinal system, where it has been found to mediate a variety of contractile, secretory and electrophysiologic effects.

Due to the broad distribution of serotonin within the body, there is lot of interest and use, in the drugs that affect serotonergic systems. Particularly, preferred are the compounds which have receptor specific agonism and/or antagonism for the treatment of a wide range of  
25 disorders, including anxiety, depression, hypertension, migraine, obesity, compulsive disorders, schizophrenia, autism, neurodegenerative disorders like Alzheimer's disease, Parkinsonism and Huntington's chorea and chemotherapy-induced vomiting (References: Gershon M. D. et. al., The peripheral actions of 5-Hydroxytryptamine (1989), 246; Saxena P. R. et. al., Journal of Cardiovascular Pharmacology (1990), supplement 7, 15).

30 The major classes of serotonin receptors (5-HT<sub>1-7</sub>) contain fourteen to eighteen separate receptors that have been formally classified (References: Glennon et al, Neuroscience and Behavioral Reviews (1990), 14, 35 and Hoyer D. et al, Pharmacol. Rev. (1994), 46, 157-203). Recently discovered information regarding sub-type identity, distribution, structure and function suggests that it is possible to identify novel, sub-type  
35 specific agents having improved therapeutic profiles with lesser side effects. The 5-HT<sub>6</sub> receptor was identified in 1993 (References: Monsma et al, Mol. Pharmacol. (1993), 43, 320-



327 and Ruat M. et al, Biochem. Biophys. Res. Com. (1993), 193, 269-276). Several antidepressants and atypical antipsychotics bind to the 5-HT<sub>6</sub> receptor with high affinity and this binding may be a factor in their profile of activities (References: Roth et al, J. Pharm. Exp. Therapeut. (1994), 268, 1403-1410; Sleight et al, Exp. Opin. Ther. Patents (1998), 8, 1217-1224; Bourson et al, Brit. J. Pharmacol. (1998), 125, 1562-1566; Boess et al, Mol. Pharmacol., 1998, 54, 577-583; Sleight et al, Brit. J. Pharmacol. (1998), 124, 556-562). In addition, 5-HT<sub>6</sub> receptor has been linked to generalized stress and anxiety states (Reference: Yoshioka et al, Life Sciences (1998), 17/18, 1473-1477). Together these studies and observations suggest that compounds that antagonize the 5-HT<sub>6</sub> receptor will be useful in treating various disorders of the central nervous system.

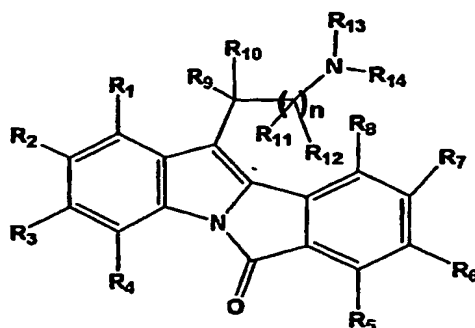
U. S. patent 4,839,377 and U. S. patent 4,855,314 refer to 5-substituted 3-aminoalkyl indoles. The compounds are said to be useful for the treatment of migraine.

International Patent Publication WO 94/06769, refers to 2-substituted-4-piperazine-benzothiophene derivatives that are serotonin 5-HT<sub>1A</sub> and 5-HT<sub>1D</sub> receptor agents useful in the treatment of anxiety, depression, migraine, stroke, angina and hypertension.

**Summary of the Invention:**

5 The present invention relates to novel tetracyclic arylcarbonyl indoles, their tautomeric forms, their stereoisomers, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates, novel intermediates described herein and pharmaceutically acceptable compositions containing them.

10 More particularly, the present invention relates to novel tetracyclic arylcarbonyl indoles of the general formula (I), their tautomeric forms, their stereoisomers, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates, novel intermediates described herein and pharmaceutically acceptable compositions containing them and use of these compounds in medicine.



General formula (I)

wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, R<sub>9</sub>, R<sub>10</sub>, R<sub>11</sub> and R<sub>12</sub> may be same or different and each independently represent hydrogen, halogen, perhaloalkyl, substituted or unsubstituted groups such as linear or branched (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>3</sub>-C<sub>7</sub>)cycloalkyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, cyclo(C<sub>3</sub>-C<sub>7</sub>)alkoxy, aryl, aryloxy, aralkyl, aralkoxy, heterocyclyl, acyl, acyloxy, acylamino, monoalkylamino, dialkylamino, hydroxyalkyl, alkoxyalkyl, aryloxyalkyl, aralkoxyalkyl, alkylthio,

sulfonic acids and its derivatives.

R<sub>13</sub> and R<sub>14</sub> may be same or different and each independently represents hydrogen, substituted or unsubstituted groups such as linear or branched (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>3</sub>-C<sub>7</sub>)cycloalkyl, optionally R<sub>13</sub> and R<sub>14</sub> along with the nitrogen atom, may form a 6 or 7-membered heterocyclic ring, wherein the ring may be further substituted, and it may have either one, two or three double bonds or "additional heteroatoms", as defined above.

"n" is an integer ranging from 1 to 2. It is preferred that n be 1.

**Partial list of such compounds of general formula (I) is as follows:**

11-(2-N,N-Dimethylaminoethyl)isoindolo[2,1-a]indol-6-one;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one hydrochloride salt;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one maleic acid salt;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one D,L-malic acid salt;  
11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one oxalate salt;  
11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one citrate salt;  
11-[(2-N-cyclopropyl-N-methylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one;  
5 11-[(2-N-cyclopropylethyl)-2-fluoroisoindolo[2,1-a]indol-6-one;  
2-Bromo-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;  
2-Chloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;  
4-Chloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;  
11-[(2-N,N-Dimethylamino)ethyl]-2-methylisoindolo[2,1-a]indol-6-one;  
10 11-[(2-N,N-Dimethylamino)ethyl]-2-methoxyisoindolo[2,1-a]indol-6-one;  
11-[(2-N,N-Dimethylamino)ethyl]-4-methoxyisoindolo[2,1-a]indol-6-one;

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(Attention Deficient Disorder/ Hyperactivity Syndrome), personality disorders, psychosis, paraphrenia, psychotic depression, mania, schizophrenia, schizophreniform disorders, withdrawal from drug abuse such as cocaine, ethanol, nicotine and benzodiazepines, panic attacks, sleep disorders (including disturbances of Circadian rhythm) and also disorders associated with spinal trauma and / or head injury such as hydrocephalus. Compounds of the invention are further expected to be of use in the treatment of mild cognitive impairment and other neurodegenerative disorders like Alzheimer's disease, Parkinsonism and Huntington's chorea.

The compounds of the invention are also expected to be of use in the treatment of certain GI (Gastrointestinal) disorders such as IBS (Irritable bowel syndrome) or chemotherapy induced emesis.

The compounds of the invention are also expected to be of use in the modulation of eating behavior and these compounds can also be used to reduce morbidity and mortality associated with the excess weight.

The present invention provides a method for the treatment of a human or a animal subject suffering from certain CNS disorders such as, anxiety, depression, convulsive disorders, obsessive-compulsive disorders, migraine headache, cognitive memory disorders e.g. Alzheimer's disease and age-related cognitive decline, ADHD (Attention Deficient Hyperactivity Disorder), personality disorders, psychosis, paraphrenia, psychotic depression, mania, schizophrenia, schizophreniform disorders, withdrawal from drug abuse such as cocaine, ethanol, nicotine and benzodiazepines, panic attacks, sleep disorders (including disturbances of Circadian rhythm) and also disorders associated with spinal trauma and /or head injury such as hydrocephalus. Compounds of the invention are further expected to be of use in the treatment of mild cognitive impairment and other neurodegenerative disorders like Alzheimer's disease, Parkinsonism and Huntington's chorea.

The present invention also provides a method for modulating 5-HT receptor function desired in certain cases.

The present invention also includes a isotopically-labelled compounds, which are identical to those defined in the general formula (I), but for the fact that one or more atoms are replaced by an atom having an atomic mass or mass number different from the atomic mass or mass number found usually in nature. Examples of isotopes that can be incorporated into compounds of the invention include isotopes of hydrogen, carbon, nitrogen,

oxygen, phosphorus, fluorine, chlorine, iodine, bromine and mTecnitium, exemplified by  $^2\text{H}$ ,  $^3\text{H}$ ,  $^{11}\text{C}$ ,  $^{13}\text{C}$ ,  $^{14}\text{C}$ ,  $^{13}\text{N}$ ,  $^{15}\text{N}$ ,  $^{15}\text{O}$ ,  $^{18}\text{F}$ ,  $^{99\text{m}}\text{Tc}$ ,  $^{31}\text{P}$ ,  $\text{S}$ ,  $^{123}\text{I}$  and  $^{125}\text{I}$ . Compounds of present invention and pharmaceutically acceptable salts and prodrugs of said compounds that contain the aforementioned isotopes and/or other isotopes of other atoms are within the scope of this invention.

Isotopically labelled compounds of the present invention are useful in drug and/or substrate tissue distribution and target occupancy assays. For example, isotopically labelled compounds are particularly useful in SPECT (single photon emission computed tomography) and in PET (positron emission tomography).

An effective amount of a compound of general formula (I) or its salt is used for producing medicaments of the present invention, along with conventional pharmaceutical auxiliaries, carriers and additives.

The present invention also relates to a pharmaceutical composition for treating and/or prophylaxis of disorders, a condition wherein modulation of 5-HT is desired in a mammal, comprising:

- a. a pharmaceutically acceptable carrier
- b. a compound of general formula (I) as defined above, and
- c. a 5-HT re-uptake inhibitor, or its pharmaceutically acceptable salt;

wherein the amounts of each active compound (a compound of general formula (I) and a 5-HT re-uptake inhibitor), is such that the combination is effective in treating such a condition.

The present invention also relates to a method of treatment and/or prophylaxis of disorders, a condition wherein modulation of 5-HT is desired in a mammal, comprising:

- a. a pharmaceutically acceptable carrier
- b. a compound of general formula (I) as defined above, and
- c. a 5-HT re-uptake inhibitor, or its pharmaceutically acceptable salt;

wherein the amounts of each active compound (a compound of general formula (I) and a 5-HT re-uptake inhibitor), is such that the combination is effective in treating such a condition.

The present invention also relates to a pharmaceutical composition for treating and/or prophylaxis of disorders, a condition wherein modulation of 5-HT is desired in a mammal, comprising:

- a. a pharmaceutically acceptable carrier
- b. a compound of general formula (I) as defined above, and
- c. a melatonergic ligand, or its pharmaceutically acceptable salt;

wherein the amounts of each active compound (a compound of general formula (I) and a melatonergic ligand), is such that the combination is effective in treating such a condition.

5 The present invention also relates to a method of treatment and/or prophylaxis of disorders, a condition wherein modulation of 5-HT is desired in a mammal, comprising:

- a. a pharmaceutically acceptable carrier
- b. a compound of general formula (I) as defined above, and
- c. a melatonergic ligand, or its pharmaceutically acceptable salt;

10 wherein the amounts of each active compound (a compound of general formula (I) and a melatonergic ligand), is such that the combination is effective in treating such a condition.

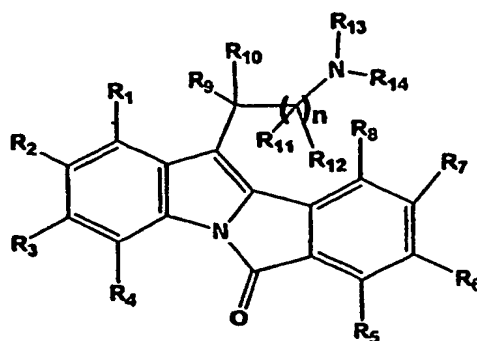
15 The present invention also relates to a process for the preparation of the above said compounds, their tautomeric forms, their stereoisomers, their geometric forms, their N-oxides, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates, novel intermediates described herein and pharmaceutical compositions containing them.

**Detailed description of the invention:**

20 The present invention relates to novel tetracyclic arylcarbonyl indoles, their tautomeric forms, their stereoisomers, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates, novel intermediates described herein and pharmaceutically acceptable compositions containing them.

25 More particularly, the present invention relates to novel tetracyclic arylcarbonyl indoles of the general formula (I), their tautomeric forms, their stereoisomers, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates, novel intermediates described herein and pharmaceutically acceptable compositions containing them and use of these compounds in medicine.





General formula (I)

wherein  $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}$  and  $R_{12}$  may be same or different and each independently represent hydrogen, halogen, perhaloalkyl, substituted or unsubstituted groups such as linear or branched  $(C_1-C_3)$ alkyl,  $(C_3-C_7)$ cycloalkyl,  $(C_1-C_3)$ alkoxy, cyclo $(C_3-C_7)$ alkoxy, aryl, aryloxy, aralkyl, aralkoxy, heterocyclyl, acyl, acyloxy, acylamino, monoalkylamino, dialkylamino, hydroxyalkyl, alkoxyalkyl, aryloxyalkyl, aralkoxyalkyl, alkylthio, sulfonic acids and its derivatives,

$R_{13}$  and  $R_{14}$  may be same or different and each independently represents hydrogen, substituted or unsubstituted groups such as linear or branched  $(C_1-C_3)$ alkyl,  $(C_3-C_7)$ cycloalkenyl,

optionally  $R_{13}$  and  $R_{14}$  along with the nitrogen atom, may form a 6 or 7-membered heterocyclic ring, wherein the ring may be further substituted, and it may have either one, two or three double bonds or "additional heteroatoms", as defined above.

"n" is an integer ranging from 1 to 2. It is preferred that n be 1.

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Suitable groups represented by  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ ,  $R_8$ ,  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  may be a halogen atom such as fluorine, chlorine, bromine or iodine; perhaloalkyl particularly perhalo( $C_1$ - $C_3$ )alkyl such as fluoromethyl, difluoromethyl, trifluoromethyl, trifluoroethyl, fluoroethyl, difluoroethyl and the like; linear or branched ( $C_1$ - $C_3$ )alkyl group, such as methyl, ethyl, n-propyl, iso-propyl, cyclo( $C_3$ - $C_7$ )alkyl group such as cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl; ( $C_1$ - $C_3$ )alkoxy group such as methoxy, ethoxy, propyloxy, iso-propyloxy; cyclo( $C_3$ - $C_7$ ) alkoxy group such as cyclopropyloxy, cyclobutyloxy, cyclopentyloxy, cyclohexyloxy, cycloheptyloxy and the like; aryl group such as phenyl or naphthyl, aralkyl group such as benzyl, phenethyl,  $C_6H_5CH_2CH_2CH_2$ , naphthylmethyl and the like, the aralkyl group may be substituted and the substituted aralkyl is a group such as  $CH_3C_6H_4CH_2$ ,  $Hal-C_6H_4CH_2$ ,  $CH_3OC_6H_4CH_2$ ,  $CH_3OC_6H_4CH_2CH_2$  and the like; aralkoxy group such as benzyloxy, phenethyloxy,

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naphthylmethyloxy, phenylpropyloxy and the like, the aralkoxy group may be substituted;  
acyl groups such as acetyl, propionyl or benzoyl, the acyl

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12A

group may be substituted; acyloxy group such as  $\text{CH}_3\text{COO}$ ,  $\text{CH}_3\text{CH}_2\text{COO}$ ,  $\text{C}_6\text{H}_5\text{COO}$  and the like which may optionally be substituted, acylamino group such as  $\text{CH}_3\text{CONH}$ ,  $\text{CH}_3\text{CH}_2\text{CONH}$ ,  $\text{C}_3\text{H}_7\text{CONH}$ ,  $\text{C}_6\text{H}_5\text{CONH}$  which may be substituted,  $(\text{C}_1\text{-C}_3)$ monoalkylamino group such as  $\text{CH}_3\text{NH}$ ,  $\text{C}_2\text{H}_5\text{NH}$ ,  $\text{C}_3\text{H}_7\text{NH}$  and the like, which may be substituted,  $(\text{C}_1\text{-C}_3)$ dialkylamino group such as  $\text{N}(\text{CH}_3)_2$ ,  $\text{CH}_3(\text{C}_2\text{H}_5)\text{N}$  and the like, which may be substituted; alkoxyalkyl group such as methoxymethyl, ethoxymethyl, methoxyethyl, ethoxyethyl and the like, which may be substituted; aryloxyalkyl group such as  $\text{C}_6\text{H}_5\text{OCH}_2$ ,  $\text{C}_6\text{H}_5\text{OCH}_2\text{CH}_2$ , naphthyloxymethyl and the like, which may be substituted; aralkoxyalkyl group such as  $\text{C}_6\text{H}_5\text{CH}_2\text{OCH}_2$ ,  $\text{C}_6\text{H}_5\text{CH}_2\text{OCH}_2\text{CH}_2$  and the like, which may be substituted;  $(\text{C}_1\text{-C}_6)$ alkylthio, sulfonic acid or its derivatives such as  $\text{SO}_2\text{NH}_2$ ,  $\text{SO}_2\text{NHCH}_3$ ,  $\text{SO}_2\text{N}(\text{CH}_3)_2$ ,  $\text{SO}_2\text{NHCF}_3$ ,  $\text{SO}_2\text{NHCO}(\text{C}_1\text{-C}_6)\text{alkyl}$ ,  $\text{SO}_2\text{NHCOaryl}$  where the aryl group is as

defined earlier and the sulfonic acid derivatives may be substituted.

$R_{13}$  and  $R_{14}$  represents hydrogen, substituted or unsubstituted linear or branched ( $C_1$ - $C_3$ )alkyl such as methyl, ethyl, n-propyl, iso-propyl, cyclo( $C_3$ - $C_7$ )alkyl group such as cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl Suitable hetero cyclic rings formed between  $R_{13}$  and  $R_{14}$  along with "Nitrogen atom" be such as pyrrolyl, pyrrolidinyl, piperidinyl, pyridine, 1,2,3,4-Tetrahydro-pyridine, imidazolyl, pyrimidinyl, pyrazinyl, piperazinyl, diazolinyl and the like; the heterocyclyl group may be substituted; heteroaryl group such as pyridyl, imidazolyl, tetrazolyl and the like, the heteroaryl group may be substituted; heterocyclo( $C_1$ - $C_6$ )alkyl, such as pyrrolidinealkyl, piperidinealkyl, morpholinealkyl, thiomorpholinealkyl, oxazolinealkyl and the like, the heterocyclo( $C_1$ - $C_6$ )alkyl group may be substituted; heteroaralkyl group such as furanmethyl, pyridinemethyl, oxazolemethyl, oxazolethyl and the like, the heteroaralkyl group may be substituted;.

In the case of the compounds of general formula (I) having an asymmetric carbon atom the present invention relates to the D-form, the L-form and D,L- mixtures and in the case of a number of asymmetric carbon atoms, the diastereomeric forms and the invention extends to each of these stereoisomeric forms and to mixtures thereof including racemates. Those compounds of general formula (I) which have an asymmetric carbon and as a rule are

Compounds of general formula (I), may be prepared from another compound of formula (I) containing  $-C(=O)$  group/s in the side chain, by known methods of reduction to the corresponding  $-C(OH,H)$  or  $-C(H,H)$  compound; and thereafter if desired or necessary carrying out steps (i), (ii) and/or (iii) as described above.

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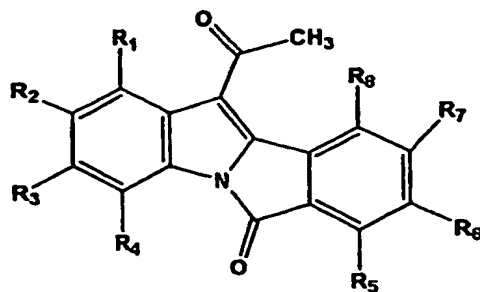
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Novel intermediates of general formula (IV) are represented as given below,

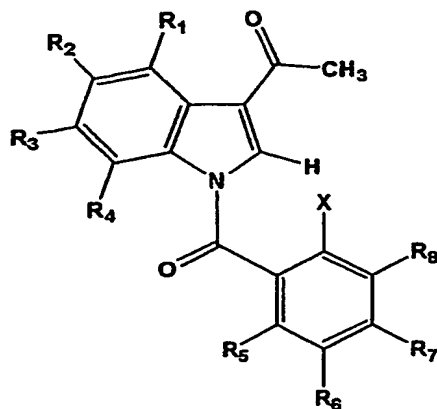


(IV)

wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  are as may be same or different and each independently represent hydrogen, halogen, perhaloalkyl, substituted or unsubstituted groups such as linear or branched (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>3</sub>-C<sub>7</sub>)cycloalkyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, cyclo(C<sub>3</sub>-C<sub>7</sub>)alkoxy, aryl, aryloxy, aralkyl, aralkoxy, heterocyclyl, acyl, acyloxy, acylamino, monoalkylamino, dialkylamino, hydroxyalkyl, alkoxyalkyl, aryloxyalkyl, aralkoxyalkyl, alkylthio,

sulfonic acids and its derivatives.

The present invention also provides method to prepare intermediate by general formula (IV), which comprises of cyclizing compounds of formula (VIII),



(VIII)

wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  are as defined above;  $X$  is halogeno such as chloro, bromo or iodo, using a  $Pd(0)$  or  $Pd(II)$  derivative as a catalyst, for example tetrakis triphenylphosphine palladium, (Bis-tri-*o*-tolylphosphine) palladium and the like in a suitable solvent.

During any of the above synthetic sequences it may be necessary and/or desirable to protect sensitive or reactive groups on any of the molecules concerned. This may be achieved by means of conventional protecting groups, such as those described in Protective Groups in Organic Chemistry, Ed J. F. W. McOmie, Plenum Press, 1973; and T. W. Greene & P. G. M. Wuts, Protective Groups in Organic Synthesis, John Wiley & Sons, 1991. For example, suitable protecting groups for the piperazine group include BOC,  $COCCl_3$ ,  $COCF_3$ .

The protecting groups may be removed according to the standard procedures.

The protecting groups may be removed at a convenient subsequent stage using methods known from the art.

The compounds of the present invention may contain one or more asymmetric centers and therefore they also exist as stereoisomers. The stereoisomers of the



compounds of the present invention may be prepared by one or more ways presented below:

- i) One or more of the reagents may be used in their optically active form.
- ii) Optically pure catalyst or chiral ligands along with metal catalyst may be employed in the reduction process. The metal catalyst may be Rhodium, Ruthenium, Indium and the like. The chiral ligands may preferably be chiral phosphines (Principles of Asymmetric synthesis, J. E. Baldwin Ed., Tetrahedron series, 14, 311-316).
- iii) The mixture of stereoisomers may be resolved by conventional methods such as forming a diastereomeric salts with chiral acids or chiral amines, or chiral amino alcohols, chiral amino acids. The resulting mixture of diastereomers may then be separated by methods such as fractional crystallization, chromatography and the like, which is followed by an additional step of isolating the optically active product by hydrolyzing the derivative (Jacques et. al., "Enantiomers, Racemates and Resolution", Wiley Interscience, 1981).
- iv) The mixture of stereoisomers may be resolved by conventional methods such as microbial resolution, resolving the diastereomeric salts formed with chiral acids or chiral bases.

Chiral acids that can be employed may be tartaric acid, mandelic acid, lactic acid, camphorsulfonic acid, amino acids and the like. Chiral bases that can be employed may be cinchona alkaloids, brucine or a basic amino acid such as lysine, arginine and the like.

The pharmaceutically acceptable salts forming a part of this invention may be prepared by treating the compound of formula (I) with 1-6 equivalents of a base such as Lithium, ammonia, substituted ammonia, sodium hydride, sodium methoxide, sodium ethoxide, sodium hydroxide, potassium t-butoxide, calcium hydroxide, calcium acetate, calcium chloride, magnesium hydroxide, magnesium chloride and the like. Solvents such as water, acetone, ether, THF, methanol, ethanol, t-butanol, dioxane, isopropanol, isopropyl ether or mixtures thereof may be used. Organic bases such lysine, arginine, methyl benzylamine, ethanolamine, diethanolamine, tromethamine, choline, guanidine and their derivatives may be used. Acid addition salts, wherever applicable may be prepared by treatment with acids such as tartaric acid, mandelic acid, fumaric acid, maleic acid, lactic acid, salicylic acid, citric acid, ascorbic acid, benzene sulfonic acid, p-toluene sulfonic acid, hydroxynaphthoic acid, methane sulfonic acid, malic acid, acetic acid, benzoic acid, succinic acid, palmitic acid, oxalic acid, hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid and the like in solvents such as water, alcohols, ethers, ethyl acetate, dioxane, DMF or a lower alkyl ketone such as acetone, or the mixtures thereof.

Different polymorphs may be prepared by crystallization of compounds of general formula (I) under different conditions such as different solvents or solvent mixtures in varying proportions for recrystallization, various ways of crystallization such as slow cooling, fast cooling or a very fast cooling or a gradual cooling during crystallization. Different polymorphs may also be obtained by heating the compound, melting the compound and solidification by gradual or fast cooling, heating or melting under vacuum or under inert atmosphere and cooling under either vacuum or inert atmosphere. The various polymorphs may be identified by either one or more of the following techniques such as differential scanning calorimeter, powder X-ray diffraction, IR spectroscopy, solid probe NMR spectroscopy and thermal microscopy.

Another aspect of the present invention comprises of a pharmaceutical composition, containing at least one of the compounds of the general formula (I); their derivatives, their tautomeric forms, their stereoisomers, their geometric forms, their polymorphs, their pharmaceutically acceptable salts, their pharmaceutically acceptable solvates thereof as an active ingredient, together with pharmaceutically employed carriers, auxiliaries and the like.

The pharmaceutical compositions of the present invention may be formulated in a conventional manner using one or more pharmaceutically acceptable carriers. Thus, the active compounds of the invention may be formulated for oral, buccal, intranasal, parental (e.g., intravenous, intramuscular or subcutaneous) or rectal administration or a form suitable for administration by inhalation or insufflation.

The dose of the active compounds can vary depending on factors such as the route of administration, age and weight of patient, nature and severity of the disease to be treated and similar factors. Therefore, any reference herein to a pharmacologically effective amount of the compounds of general formula (I) refers to the aforementioned factors.

For oral administration, the pharmaceutical compositions may take the form of, for example, tablets or capsules prepared by conventional means with pharmaceutically acceptable excipients such as binding agents (e.g., pregelatinised maize starch, polyvinylpyrrolidone or hydroxypropyl methylcellulose); fillers (e.g., lactose, microcrystalline cellulose or calcium phosphate); lubricants (e.g., magnesium stearate, talc or silica); disintegrants (e.g., potato starch or sodium starch glycolate); or wetting agents (e.g., sodium lauryl sulphate). The tablets may be coated by methods well known in the art. Liquid preparations for oral administration may take the form of, for example, solutions, syrups or suspensions, or they may be presented as a dry product for constitution with water or other suitable vehicle before use. Such liquid preparations may be prepared by conventional means with pharmaceutically acceptable additives such as suspending agents (e.g., sorbitol

syrup, methyl cellulose or hydrogenated edible fats); emulsifying agents (e.g., lecithin or acacia); non-aqueous vehicles (e.g., almond oil, oily esters or ethyl alcohol); and preservatives (e.g., methyl or propyl p-hydroxybenzoates or sorbic acid).

For buccal administration, the composition may take the form of tablets or lozenges  
5 formulated in conventional manner.

The active compounds of the invention may be formulated for parenteral administration by injection, including using conventional catheterization techniques or infusion. Formulations for injection may be presented in unit dosage form, e.g., in ampoules or in multi-dose containers, with an added preservative. The compositions may take such  
10 forms as suspensions, solutions or emulsions in oily or aqueous vehicles, and may contain formulating agents such as suspending, stabilizing and/or dispersing agents. Alternatively, the active ingredient may be in powder form for reconstitution with a suitable vehicle, e.g., sterile pyrogen-free water, before use.

The active compounds of the invention may also be formulated in rectal compositions  
15 such as suppositories or retention enemas, e.g., containing conventional suppository bases such as cocoa butter or other glycerides.

For intranasal administration or administration by inhalation, the active compounds of the invention are conveniently delivered in the form of an aerosol spray from a pressurized container or a nebulizer, or from a capsule using an inhaler or insufflator. In the case of a  
20 pressurized aerosol, a suitable propellant, e.g., dichlorodifluoromethane, trichlorofluoromethane, dichlorotetrafluoroethane, carbon dioxide or other suitable gas and the dosage unit may be determined by providing a valve to deliver a metered amount. The medicament for pressurized container or nebulizer may contain a solution or suspension of the active compound while for a capsule it preferably should be in the form of powder.  
25 Capsules and cartridges (made, for example, from gelatin) for use in an inhaler or insufflator may be formulated containing a powder mix of a compound of the invention and a suitable powder base such as lactose or starch.

A proposed dose of the active compounds of this invention, for either oral, parenteral, nasal or buccal administration, to an average adult human, for the treatment of the  
30 conditions referred to above, is 0.1 to 200 mg of the active ingredient per unit dose which could be administered, for example, 1 to 4 times per day.

Aerosol formulations for treatment of the conditions referred to above (e.g., migraine) in the average adult human are preferably arranged so that each metered dose or "puff" of aerosol contains 20 µg to 1000 µg of the compound of the invention. The overall daily dose  
35 with an aerosol will be within the range 100 µg to 10 mg. Administration may be several times daily, for example 2, 3, 4 or 8 times, giving for example, 1, 2 or 3 doses each time.

The affinities of the compound of this invention for the various serotonin receptors are evaluated using standard radioligand binding assays and are described here.

**Radioligand binding assays for various 5-HT receptor sub-types :**

5 i) **Assay for 5HT<sub>1A</sub>**

**Materials and Methods:**

Receptor source : Human recombinant expressed in HEK-293 cells

Radioligand : [<sup>3</sup>H]-8-OH-DPAT (221 Ci/mmol)

Final ligand concentration - [0.5 nM]

10 Reference compound : 8-OH-DPAT

Positive control : 8-OH-DPAT

**Incubation conditions :**

15 Reactions are carried out in 50 mM TRIS-HCl (pH 7.4) containing 10 mM MgSO<sub>4</sub>, 0.5 mM EDTA and 0.1% Ascorbic acid at room temperature for 1 hour. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the 5HT<sub>1A</sub> binding site.

20 **Literature Reference:**

- Hoyer D., Engel G., et al. Molecular Pharmacology of 5HT<sub>1</sub> and 5-HT<sub>2</sub> Recognition Sites in Rat and Pig Brain Membranes: Radioligand Binding Studies with [<sup>3</sup>H]-5HT, [<sup>3</sup>H]-8-OH-DPAT, [<sup>125</sup>I]-Iodocyanopindolol, [<sup>3</sup>H]-Mesulergine and [<sup>3</sup>H]-Ketanserin. Eur. J. Pharmacol. 118: 13-23 (1985) with modifications.
- 25 • Schoeffter P. and Hoyer D. How Selective is GR 43175? Interactions with Functional 5-HT<sub>1A</sub>, 5HT<sub>1B</sub>, 5-HT<sub>1C</sub>, and 5-HT<sub>1D</sub> Receptors. Naunyn-Schmiedeberg's Arch. Pharmac. 340: 135-138 (1989) with modifications.

ii) **Assay for 5HT<sub>1B</sub>**

30 **Materials and Methods:**

Receptor source : Rat striatal membranes

Radioligand : [<sup>125</sup>I]Iodocyanopindolol (2200 Ci/mmol)

Final ligand concentration - [0.15 nM]

Non-specific determinant : Serotonin - [10 μM]

35 Reference compound : Serotonin

Positive control : Serotonin

**Incubation conditions :**

Reactions are carried out in 50 mM TRIS-HCl (pH 7.4) containing 60  $\mu$ M (-) isoproterenol at 37°C for 60 minutes. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the 5HT<sub>1B</sub> binding site.

**Literature Reference:**

- Hoyer D., Engel G., et al. Molecular Pharmacology of 5HT<sub>1</sub> and 5-HT<sub>2</sub> Recognition Sites in Rat and Pig Brain Membranes: Radioligand Binding Studies with [<sup>3</sup>H]-5HT, [<sup>3</sup>H]-8-OH-DPAT, [<sup>125</sup>I]-Iodocyanopindolol, [<sup>3</sup>H]-Mesulergine and [<sup>3</sup>H]-Ketanserin. *Eur. Jml. Pharmacol.* 118: 13-23 (1985) with modifications.
- Schoeffter P. and Hoyer D. How selective is GR 43175? Interactions with Functional 5-HT<sub>1A</sub>, 5HT<sub>1B</sub>, 5-HT<sub>1C</sub>, and 5-HT<sub>1</sub> Receptors. *Naunyn-Schmiedeberg's Arch. Pharmac.* 340: 135-138 (1989) with modifications.

**iii) Assay for 5HT<sub>1D</sub>****Materials and Methods:**

Receptor source : Human cortex

Radioligand : [<sup>3</sup>H] 5-Carboxamidotryptamine (20-70 Ci/mmol)

Final ligand concentration - [2.0 nM]

Non-specific determinant : 5-Carboxamidotryptamine (5-CT) - [1.0  $\mu$ M]

Reference compound : 5-Carboxamidotryptamine (5-CT)

Positive control : 5-Carboxamidotryptamine (5-CT)

**Incubation conditions :**

Reactions are carried out in 50 mM TRIS-HCl (pH 7.7) containing 4 mM CaCl<sub>2</sub>, 100 nM 8-OH-DPAT, 100 nM Mesulergine, 10  $\mu$ M Pargyline and 0.1% ascorbic acid at 25 °C for 60 minutes. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the cloned 5HT<sub>1D</sub> binding site.

**Literature Reference:**

- Waeber C., Schoeffter, Palacios J.M. and Hoyer D. Molecular Pharmacology of the 5-HT<sub>1D</sub> Recognition Sites: Radioligand Binding Studies in Human, Pig, and Calf Brain

Membranes. Naunyn-Schmiedeberg's Arch. Pharmacol. 337: 595-601 (1988) with modifications.

iv) Assay for 5HT<sub>2A</sub>

5 Materials and Methods:

Receptor source : Human Cortex

Radioligand : [<sup>3</sup>H] Ketanserin (60-90 Ci/mmol)

Final ligand concentration - [2.0 nM]

Non-specific determinant : Ketanserin - [3.0 μM]

10 Reference compound : Ketanserin

Positive control : Ketanserin

Incubation conditions :

Reactions are carried out in 50 mM TRIS-HCl (pH 7.5) at room temperature for 90 minutes. The reaction is terminated by rapid vacuum filtration onto glass fiber filters.

15 Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the 5HT<sub>2A</sub> binding site.

Literature Reference:

• Leysen J. E., Niemegeers C. J., Van Nueten J. M. and Laduron P. M. [<sup>3</sup>H]Ketanserin: A Selective Tritiated Ligand for Serotonin<sub>2</sub> Receptor Binding Sites. Mol. Pharmacol. 21: 301-314 (1982) with modifications.

20 • Martin, G. R. and Humphrey, P. P. A. Classification Review: Receptors for 5-HT: Current Perspectives on Classification and Nomenclature. Neuropharmacol. 33(3/4): 261-273 (1994).

25 v) Assay for 5HT<sub>2C</sub>

Materials and Methods:

Receptor source : Pig choroid plexus membranes

Radioligand : [<sup>3</sup>H] Mesulergine (50-60 Ci/mmol)

Final ligand concentration - [1.0 nM]

30 Non-specific determinant : Serotonin - [100 μM]

Reference compound : Mianserin

Positive control : Mianserin

Incubation conditions :

35

Reactions are carried out in 50 mM TRIS-HCl (pH 7.7) containing 4 mM CaCl<sub>2</sub> and 0.1% ascorbic acid at 37 °C for 60 minutes. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the 5HT<sub>2C</sub> binding site.

Literature Reference:

- A. Pazos, D. Hoyer, and J. Palacios. The Binding of Serotonergic Ligands to the Porcine Choroid Plexus: Characterization of a New Type of Serotonin Recognition Site. Eur. J. Pharmacol. 106: 539-546 (1985) with modifications.
- Hoyer, D., Engel, G., et al. Molecular Pharmacology of 5HT<sub>1</sub> and 5-HT<sub>2</sub> Recognition Sites in Rat and Pig Brain Membranes: Radioligand Binding Studies with [3H]-5HT, [3H]-8-OH-DPAT, [<sup>125</sup>I]-Iodocyanopindolol, [3H]-Mesulergine and [3H]-Ketanserin. Eur. J. Pharmacol. 118: 13-23 (1985) with modifications.

vi) Assay for 5HT<sub>3</sub>

Materials and Methods:

Receptor source : N1E-115 cells  
Radioligand : [<sup>3</sup>H]-GR 65630 (30-70 Ci/mmol)  
Final ligand concentration - [0.35 nM]  
Non-specific determinant : MDL-72222 - [1.0 µM]  
Reference compound : MDL-72222  
Positive control : MDL-72222

Incubation conditions :

Reactions are carried out in 20 mM HEPES (pH 7.4) containing 150 mM NaCl at 25 °C for 60 minutes. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the 5HT<sub>3</sub> binding site.

Literature Reference:

- Lummis S. C. R., Kilpatrick G. J. Characterization of 5HT<sub>3</sub> Receptors in Intact N1E-115 Neuroblastoma Cells. Eur. J. Pharmacol. 189: 223-227 (1990) with modifications.
- Hoyer D. and Neijt H. C. Identification of Serotonin 5-HT<sub>3</sub> Recognition Sites in Membranes of N1E-115 Neuroblastoma Cells by Radioligand Binding. Mol. Pharmacol. 33: 303 (1988).

- Tyers M. B. 5-HT<sub>3</sub> Receptors and the Therapeutic Potential of 5HT<sub>3</sub> Receptor Antagonists. Therapie. 46:431-435 (1991).

#### vii) Assay for 5HT<sub>4</sub>

##### 5 Materials and Methods:

Receptor source : Guinea pig striatal membranes

Radioligand : [<sup>3</sup>H] GR-113808 (30-70 Ci/mmol)

Final ligand concentration - [0.2 nM]

Non-specific determinant : Serotonin (5-HT) - [30 µM]

10 Reference compound : Serotonin (5-HT)

Positive control : Serotonin (5-HT)

##### Incubation conditions :

15 Reactions are carried out in 50 mM HEPES (pH 7.4) at 37°C for 60 minutes. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the 5HT<sub>4</sub> binding site.

##### Literature Reference:

- Grossman Kilpatrick, C., et al. Development of a Radioligand Binding Assay for 5HT<sub>4</sub> Receptors in Guinea Pig and Rat Brain. Brit. J Pharmco. 109: 618-624 (1993).

#### viii) Assay for 5HT<sub>5A</sub>

##### Materials and Methods:

Receptor source : Human recombinant expressed in HEK 293 cells

25 Radioligand : [<sup>3</sup>H] LSD (60-87 Ci/mmol)

Final ligand concentration - [1.0 nM]

Non-specific determinant : Methiothepin mesylate - [1.0 µM]

Reference compound : Methiothepin mesylate

Positive control : Methiothepin mesylate

##### 30 Incubation conditions :

Reactions are carried out in 50 mM TRIS-HCl (pH 7.4) containing 10 mM MgSO<sub>4</sub> and 0.5 mM EDTA at 37 °C for 60 minutes. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound with the  
35 cloned 5HT<sub>5A</sub> binding site.



**Literature Reference:**

- Rees S., et al. FEBS Letters, 355: 242-246 (1994) with modifications

**ix) Assay for 5HT<sub>6</sub>****5 Materials and Methods:**

Receptor source : Human recombinant expressed in HEK293 cells

Radioligand : [<sup>3</sup>H]LSD (60-80 Ci/mmol)

Final ligand concentration - [1.5 nM]

Non-specific determinant : Methiothepin mesylate - [0.1 μM]

10 Reference compound : Methiothepin mesylate

Positive control : Methiothepin mesylate

**Incubation conditions :**

15 Reactions are carried out in 50 mM TRIS-HCl (pH 7.4) containing 10 mM MgCl<sub>2</sub>, 0.5 mM EDTA for 60 minutes at 37 °C. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control values in order to ascertain any interactions of test compound(s) with the cloned serotonin - 5HT<sub>6</sub> binding site.

**Literature Reference:**

- Monsma F. J. Jr., et al., Molecular Cloning and Expression of Novel Serotonin Receptor with High Affinity for Tricyclic Psychotropic Drugs. Mol. Pharmacol. (43): 320-327 (1993).

**x) Assay for 5-HT<sub>7</sub>****Materials and Methods:**

Receptor source : Human recombinant expressed in CHO cells

Radioligand : [<sup>3</sup>H]LSD (60-80 Ci/mmol)

25 Final ligand concentration - [2.5 nM]

Non-specific determinant : 5-Carboxamidotryptamine (5-CT) - [0.1 μM]

Reference compound : 5-Carboxamidotryptamine

Positive control : 5-Carboxamidotryptamine

**30 Incubation conditions :**

Reactions are carried out in 50 mM TRIS-HCl (pH 7.4) containing 10 mM MgCl<sub>2</sub>, 0.5 mM EDTA for 60 minutes at 37 °C. The reaction is terminated by rapid vacuum filtration onto glass fiber filters. Radioactivity trapped onto the filters is determined and compared to control

values in order to ascertain any interactions of test compound(s) with the cloned serotonin - 5HT<sub>7</sub> binding site.

Literature Reference:

- Y. Shen, E. Monsma, M. Metcalf, P. Jose, M Hamblin, D. Sibley, Molecular Cloning and  
5 Expression of a 5-hydroxytryptamine<sub>7</sub> Serotonin Receptor Subtype. J. Biol. Chem. 268:  
18200-18204.

10 The following description illustrates the method of preparation of variously substituted compounds of general formula (I), according to the methods described herein. These are provided by the way of illustration only and therefore should not be construed to limit the scope of the invention.

Commercial reagents were utilized without further purification. Room temperature refers to 25 - 30 °C. Melting points are uncorrected. IR spectra were taken using KBr and in solid state. Unless otherwise stated, all mass spectra were carried out using ESI conditions. <sup>1</sup>H NMR spectra were recorded at 300 MHz on a Bruker instrument. Deuterated chloroform (99.8 % D) was used as solvent. TMS was used as internal reference standard. Chemical shift values are expressed in are reported in parts per million (δ)-values. The following abbreviations are used for the multiplicity for the NMR signals: s=singlet, bs=broad singlet, d=doublet, t=triplet, q=quartet, qui=quintet, h=heptet, dd=double doublet, dt=double triplet, tt=triplet of triplets, m=multiplet. NMR, mass were corrected for background peaks. Specific  
15 rotations were measured at room temperature using the sodium D (589 nm). Chromatography refers to column chromatography performed using 60 – 120 mesh silica gel and executed under nitrogen pressure (flash chromatography) conditions.

Description 1 : N,N-Dimethyl-1-(2'-bromobenzoyl)tryptamine (D1)

25 A suspension of potassium hydride (15.0 mmoles, 2.0 g. (30 % suspension in mineral oil), washed with THF before use), in 30 mL of THF was stirred and cooled at 10 °C. To this cooled solution was added a solution of N,N-dimethyltryptamine (15 mmoles), in THF, slowly, over 15 min., maintaining the temperature below 10 °C. After that a solution of 2-bromobenzoyl chloride in THF (15 mmoles, in 10 mL of THF) was then added under nitrogen blanket and the reaction temperature was maintained below 10 °C (Exothermic reaction).  
30 Further, the reaction mixture was maintained at 20 - 25 °C for further 2 - 4 hrs. After completion of reaction (TLC), the excess of THF was distilled off and the concentrate was diluted with ice-water and extracted with ethyl acetate. Combined ethyl acetate layer was washed with water, dried over sodium sulfate and evaporated under reduced pressure, below 50 °C.

The crude residue was purified by silica gel column chromatography using 30 % methanol in ethyl acetate as a mobile phase, to obtain the intermediate, N,N-Dimethyl-1-(2'-bromobenzoyl)tryptamine, which was identified by IR, NMR and mass spectral analyses.

#### 5 Description 2 – 21 (D2 – D21) :

Various indole intermediates were reacted with substituted 2-bromobenzoyl chloride according to the procedure described in the description 1. These compounds were identified by IR, NMR and mass spectral analyses. The following list includes list of such compounds.

#### 10 List – 1 :

	Description	Mass ion (M+H) <sup>+</sup>
D 1	2-[1-(2-Bromobenzoyl)indol3-yl]ethyl-N,N-dimethylamine	371
D 2	2-[1-(2-Bromobenzoyl)-5-bromoindol3-yl]ethyl-N,N-dimethylamine	449
D 3	2-[1-(2-Bromobenzoyl)-5-chloroindol3-yl]ethyl-N,N-dimethylamine	405
D 4	2-[1-(2-Bromobenzoyl)-5-fluoroindol3-yl]ethyl-N,N-dimethylamine	389
D 5	2-[1-(2-Bromobenzoyl)-5-methylindol3-yl]ethyl-N,N-dimethylamine	385
D 6	2-[1-(2-Bromobenzoyl)-5-methoxyindol3-yl]ethyl-N,N-dimethylamine	401
D 7	2-[1-(2-Bromobenzoyl)-7-ethylindol3-yl]ethyl-N,N-dimethylamine	399
D 8	2-[1-(2-Bromobenzoyl)-7-chloroindol3-yl]ethyl-N,N-dimethylamine	405
D 9	2-[1-(2-Bromobenzoyl)-7-methoxyindol3-yl]ethyl-N,N-dimethylamine	401
D 10	2-[1-(2-Bromobenzoyl)-7-trifluoromethylindol3-yl]ethyl-N,N-dimethylamine	439
D 11	2-[1-(2-Bromobenzoyl)-5,7-dichloroindol3-yl]ethyl-N,N-dimethylamine	439
D 12	2-[1-(2-Bromobenzoyl)-6,7-dichloroindol3-yl]ethyl-N,N-dimethylamine	439
D 13	2-[1-(2-Bromobenzoyl)-5,7-difluoroindol3-yl]ethyl-N,N-dimethylamine	407
D 14	2-[1-(2-Bromobenzoyl)-5,7-dimethylindol3-yl]ethyl-N,N-dimethylamine	399
D 15	2-[1-(2-Bromobenzoyl)-6,7-dimethylindol3-yl]ethyl-N,N-dimethylamine	399
D 16	2-[1-(2-Bromobenzoyl)-4-chloro-7-methylindol3-yl]ethyl-N,N-dimethylamine	419
D 17	2-[1-(2-Bromobenzoyl)-6-chloro-7-methylindol3-yl]ethyl-N,N-dimethylamine	419
D 18	2-[1-(2-Bromobenzoyl)-4,5,7-trichloroindol3-yl]ethyl-N,N-dimethylamine	473
D 19	2-[1-(2-Bromobenzoyl)indol3-yl]-1-hydroxyethyl-N,N-dimethylamine	387
D 20	1-(2-Bromobenzoyl)-5-bromo-3-(2-(morpholino-1-yl)ethyl)-1H-indole	491
D 21	1-(2-Bromobenzoyl)-(2-(4-methyl-piperazin-1-yl)ethyl)-1H-indole	504

**Example - 1 : 11-(2-N,N-Dimethylaminoethyl)isoindolo[2,1-a]indol-6-one**

1-(2'-bromobenzoyl)-N,N-dimethyltryptamine (0.286 moles) was taken in a 100 mL 3 necked round bottomed flask, along with N,N-dimethyl acetamide (40 mL), potassium acetate (0.286 moles, 0.281 g.) and dichloro bis(tri-o-tolylphosphine)palladium (0.0143 5 moles, 0.0126 g.). The reaction mixture was maintained under nitrogen atmosphere and was heated to 160 °C with stirring for 16 hrs. After the completion of reaction (TLC), excess of dimethyl acetamide was distilled off under reduced pressure.

The residue obtained was purified by silica gel column chromatography using 20 % methanol in ethyl acetate as an eluent, to afford the title compound, which was identified by 10 IR, NMR and mass spectral analyses. The final desired compound of general formula (I) can be further purified by preparation of their acid addition salts. IR spectra (cm<sup>-1</sup>) : 2939, 2779, 1721, 1446; Mass (m/z) : 291 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.38 (6H, s), 2.57 - 2.69 (2H, m), 3.00 - 3.10 (2H, m), 7.12 - 7.90 (8H, m).

**Example - 2 : 11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one**

15 Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Melting range (°C) : 112- 117; IR spectra (cm<sup>-1</sup>) : 2940, 2780, 1730, 1466, 1446; Mass (m/z) : 309 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.36 (6H, s), 2.57 - 2.65 (2H, m), 2.95 - 3.00 (2H, m), 6.93 - 7.81 (7H, m).

**Example - 3 : 11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one 20 hydrochloride salt**

Example no. 2 (199 mg) was dissolved in 30 mL ether. To this clear solution a mixture of isopropylalcohol-hydrochloric acid (10 mL) was added. Immediately a white precipitate separates out, which was filtered, washed with ether and dried. Melting range (°C) : >250 (dec).

**Example - 4 : 11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one 25 maleic acid salt**

Example no. 2 (205 mg) was dissolved in 30 mL ether. To this clear solution a solution of maleic acid (82 mg, dissolved in 30 mL ether + 5 mL methanol) was added. 30 Immediately a white precipitate separates out, which was filtered, washed with ether and dried. Melting range (°C) : 180 - 182 (dec).

**Example - 5 : 11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one 35 D,L-malic acid salt**

Example no. 2 (208 mg) was dissolved in 30 mL ether. To this clear solution a solution of D,L- malic acid (106 mg, dissolved in 30 mL ether + 5 mL methanol) was added. Immediately a white precipitate separates out, which was filtered, washed with ether and dried. Melting range (°C) : 170 - 173.

5

Example - 6 : 11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one oxalate salt

Example no. 2 (203 mg) was dissolved in 30 mL ether. To this clear solution a solution of oxalic acid (94 mg, dissolved in 30 mL ether + 5 mL methanol) was added. Immediately a white precipitate separates out, which was filtered, washed with ether and dried. Melting range (°C) : 244 - 246 (dec).

10

Example - 7 : 11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one citrate salt

15

Example no. 2 (201 mg) was dissolved in 30 mL ether. To this clear solution a solution of citric acid (134 mg, dissolved in 30 mL ether + 5 mL methanol) was added. Immediately a white precipitate separates out, which was filtered, washed with ether and dried. Melting range (°C) : 178 - 180.

20

Example - 8 : 2-Bromo-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Melting range (°C) : 118 - 121; IR spectra (cm<sup>-1</sup>) : 2942, 2759, 1718, 1444, 882, 761; Mass (m/z) : 369 (M+H)<sup>+</sup>, 371 (M+3)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.36 (6H, s), 2.57 - 2.65 (2H, m), 2.95 - 3.00 (2H, m), 7.29 - 7.77 (7H, m).

25

Example - 9 : 2-Chloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. IR spectra (cm<sup>-1</sup>) : 2925, 2765, 1723, 1446, 1381, 758, 700; Mass (m/z) : 325 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.32 (6H, s), 2.54 - 2.62 (2H, m), 2.76 - 2.84 (2H, m), 7.27 - 7.73 (7H, m).

30

Example - 10 : 4-Chloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. IR spectra (cm<sup>-1</sup>) : 2942, 2779, 1746, 1417, 1343, 782, 700; Mass (m/z) : 325 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.90 (6H, s), 3.27 - 3.31 (2H, m), 3.52 - 3.57 (2H, m), 7.07 - 8.09 (7H, m).

35

**Example - 11 : 11-[(2-N,N-Dimethylamino)ethyl]-2-methylisoindolo[2,1-a]indol-6-one**

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Melting range (°C) : 116 - 128; IR spectra (cm<sup>-1</sup>) : 2941, 2761, 1714, 1611, 1468; Mass (m/z) : 305 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.39 (6H, s), 2.42 (3H, s), 2.57 - 2.76 (2H, m), 2.99 - 3.07 (2H, m), 7.07 - 7.67 (7H, m).

**Example - 12 : 11-[(2-N,N-Dimethylamino)ethyl]-2-methoxyisoindolo[2,1-a]indol-6-one**

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. IR spectra (cm<sup>-1</sup>) : 2941, 2773, 1466, 1371, 1237; Mass (m/z) : 321 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.39 (6H, s), 2.60 - 2.68 (2H, m), 2.98 - 3.06 (2H, m), 3.85 (3H, s), 6.84 - 7.66 (7H, m).

**Example - 13 : 11-[(2-N,N-Dimethylamino)ethyl]-4-methoxyisoindolo[2,1-a]indol-6-one**

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. IR spectra (cm<sup>-1</sup>) : 2941, 2773, 1728, 1466, 1230; Mass (m/z) : 321 (M+H)<sup>+</sup>.

**Example - 14 : 11-[(2-N,N-Dimethylamino)ethyl]-4-trifluoromethylisoindolo[2,1-a]indol-6-one**

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 359 (M+H)<sup>+</sup>.

**Example - 15 : 11-[(2-N,N-Dimethylamino)ethyl]-4-ethylisoindolo[2,1-a]indol-6-one**

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 319 (M+H)<sup>+</sup>.

**Example - 16 : 11-[(2-N,N-Dimethylamino)ethyl]-2,4-difluoroisoindolo[2,1-a]indol-6-one**

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 327 (M+H)<sup>+</sup>.

**Example - 17 : 2,4-Dichloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one**

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 359 (M+H)<sup>+</sup>.

Example - 18 : 3,4-Dichloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 359 (M+H)<sup>+</sup>.

5

Example - 19 : 1,2,4-Trichloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 393 (M+H)<sup>+</sup>.

10

Example - 20 : 11-[(2-N,N-Dimethylamino)ethyl]-2,4-dimethylisoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Melting range (°C) : 100 - 102; IR spectra (cm<sup>-1</sup>) : 2942, 2758, 1721, 1449, 1242; Mass (m/z) : 319 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.36 (3H, s), 2.38 (6H, s), 2.61 - 2.65 (2H, m), 2.84 (3H, m), 2.97 - 3.00 (2H, s), 6.87 - 7.75 (6H, m).

15

Example - 21 : 11-[(2-N,N-Dimethylamino)ethyl]-3,4-dimethylisoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Melting range (°C) : 119 - 121; IR spectra (cm<sup>-1</sup>) : 2941, 2762, 1719, 1305; Mass (m/z) : 319 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.35 (3H, s), 2.38 - 2.40 (6H, s), 2.61 - 2.65 (2H, m), 2.86 (3H, m), 2.98 - 3.06 (2H, s), 6.98 - 7.76 (6H, m).

20

25

Example - 22 : 1-Chloro-11-[(2-N,N-dimethylamino)ethyl]-4-methylisoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 339 (M+H)<sup>+</sup>.

30

Example - 23 : 3-Chloro-11-[(2-N,N-dimethylamino)ethyl]-4-methylisoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 339 (M+H)<sup>+</sup>.

35

Example - 24 : 11-[(2-N,N-Dimethylamino)propyl]-4-methylisoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Mass (m/z) : 305 (M+H)<sup>+</sup>.

5 Example - 25 : 2-Bromo-11-[(2-morpholin-1-yl)ethyl]isoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Melting range (°C) : 148 - 151; IR spectra (cm<sup>-1</sup>) : 2956, 2806, 1733, 1438, 1360; Mass (m/z) : 411 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.56 - 2.63 (4H, t), 2.63 - 2.71 (2H, m), 2.98 - 3.06 (2H, m), 3.74 - 3.78 (4H, t), 7.31 - 7.79 (7H, m).

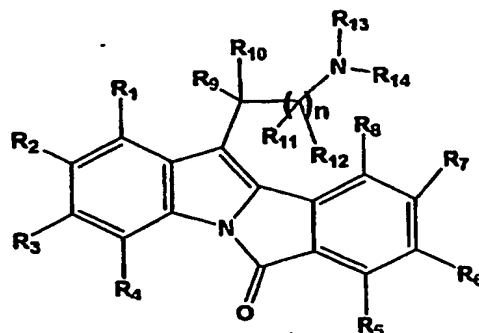
10 Example - 26 : 2-Bromo-11-[2-(4-methylpiperazin-1-yl)ethyl]isoindolo[2,1-a]indol-6-one

Using essentially the general procedure described in example 1 and some non-critical variations, the above derivative was prepared. Melting range (°C) : 146 - 150; IR spectra (cm<sup>-1</sup>) : 2940, 2790, 1725, 1440, 1357, 801, 703; Mass (m/z) : 424 (M+H)<sup>+</sup>; <sup>1</sup>H-NMR (δ ppm) : 2.28 - 2.32 (3H, t), 2.52 - 2.75 (10H, m), 2.98 - 3.05 (2H, m), 7.30 - 7.78 (7H, m).



**Claims**

1. A compound of the general formula (I),



**General Formula (I)**

its tautomeric forms, its stereoisomers, its polymorphs, its pharmaceutically acceptable salts and solvates,

wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ ,  $R_8$ ,  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  may be same or different and each independently represent hydrogen, halogen, perhaloalkyl, substituted or unsubstituted groups such as linear or branched  $(C_1-C_3)$ alkyl,  $(C_3-C_7)$ cycloalkyl,  $(C_1-C_3)$ alkoxy, cyclo $(C_3-C_7)$ alkoxy, aryl, aryloxy, aralkyl, aralkoxy, heterocyclyl, acyl, acyloxy, acylamino, monoalkylamino, dialkylamino, hydroxyalkyl, alkoxyalkyl, aryloxyalkyl, aralkoxyalkyl, alkylthio, sulfonic acids and its derivatives,

$R_{13}$  and  $R_{14}$  may be same or different and each independently represents hydrogen, substituted or unsubstituted groups such as linear or branched ( $C_1$ - $C_3$ )alkyl, ( $C_3$ - $C_7$ )cycloalkyl, optionally  $R_{13}$  and  $R_{14}$  along with the nitrogen atom, may form a 6 or 7-membered heterocyclic ring, wherein the ring may be further substituted, and it may have either one, two or three double bonds or "additional heteroatoms", as defined above.

"n" is an integer ranging from 1 to 2. It is preferred that n be 1.

2. A compound according to Claim -1, which is selected from the group consisting of:

11-(2-N,N-Dimethylaminoethyl)isoindolo[2,1-a]indol-6-one;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one hydrochloride salt;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one maleic acid salt;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one D,L-malic acid salt;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one oxalate salt;

11-[(2-N,N-Dimethylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one citrate salt;

11-[(2-N-cyclopropyl-N-methylamino)ethyl]-2-fluoroisoindolo[2,1-a]indol-6-one;

11-[2-N-cyclopropylaminoethyl]-2-fluoroisoindolo[2,1-a]indol-6-one;

2-Bromo-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;

2-Chloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;

4-Chloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;

11-[(2-N,N-Dimethylamino)ethyl]-2-methylisoindolo[2,1-a]indol-6-one;

- 11-[(2-N,N-Dimethylamino)ethyl]-2-methoxyisoindolo[2,1-a]indol-6-one;  
11-[(2-N,N-Dimethylamino)ethyl]-4-methoxyisoindolo[2,1-a]indol-6-one;  
11-[(2-N,N-Dimethylamino)ethyl]-4-trifluoromethylisoindolo[2,1-a]indol-6-one;  
11-[(2-N,N-Dimethylamino)ethyl]-4-ethylisoindolo[2,1-a]indol-6-one;  
5 11-[(2-N,N-Dimethylamino)ethyl]-2,4-difluoroisoindolo[2,1-a]indol-6-one;  
2,4-Dichloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;  
3,4-Dichloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;  
1,2,4-Trichloro-11-[(2-N,N-dimethylamino)ethyl]isoindolo[2,1-a]indol-6-one;  
11-[(2-N,N-Dimethylamino)ethyl]-2,4-dimethylisoindolo[2,1-a]indol-6-one;  
10 11-[(2-N,N-Dimethylamino)ethyl]-3,4-dimethylisoindolo[2,1-a]indol-6-one;  
1-Chloro-11-[(2-N,N-dimethylamino)ethyl]-4-methylisoindolo[2,1-a]indol-6-one;  
3-Chloro-11-[(2-N,N-dimethylamino)ethyl]-4-methylisoindolo[2,1-a]indol-6-one;  
11-[(2-N,N-Dimethylamino)propyl]-4-methylisoindolo[2,1-a]indol-6-one;  
3-Chloro-11-[(2-N-methylamino)ethyl]-4-methylisoindolo[2,1-a]indol-6-one;  
15 3-Chloro-11-[(2-N-methyl-N-acetylamino)ethyl]-4-methylisoindolo[2,1-a]indol-6-one;  
3-Chloro-11-[(2-N-methylamino)ethyl]-2-methoxyisoindolo[2,1-a]indol-6-one;  
3-Chloro-11-[(2-N-methylamino)ethyl]-2-sulfoamidoisoindolo[2,1-a]indol-6-one;  
3-Iodo-11-[(2-N-methylamino)ethyl]-2-methoxyisoindolo[2,1-a]indol-6-one;  
2-Bromo-11-[(2-morpholin-1-yl)ethyl]isoindolo[2,1-a]indol-6-one;  
20 2-Bromo-11-[2-(4-methylpiperazin-1-yl)ethyl]isoindolo[2,1-a]indol-6-one;  
and its stereoisomers, its N-oxides, its polymorphs, its pharmaceutically acceptable salts and solvates.
3. A pharmaceutical composition comprising either of a pharmaceutically acceptable  
25 carrier, diluent/s, excipient/s or solvates along with a therapeutically effective amount of  
a compound according to Claim-1, its tautomeric forms, its stereoisomers, its geometric  
forms, its N-oxides, its polymorphs, its pharmaceutically acceptable salts, or solvates.

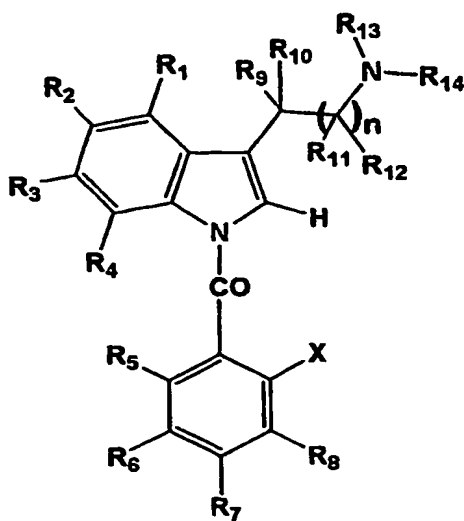
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4. A pharmaceutical composition according to Claim-3, in the form of a tablet, capsule, powder, lozenges, suppositories, syrup, solution, suspension or injectable, administered in, as a single dose or multiple dose units.
- 5 5. Use of compound of general formula (I), as defined in Claim-1 or a pharmaceutical composition as defined in Claim-3 for preparing medicaments.
6. Use of compound of general formula (I), as defined in Claim-1 or a pharmaceutical composition as defined in Claim-3 for the treatment where a modulation of 5-HT activity  
10 is desired.
7. Use of a compound as claimed in Claim-1 for the manufacture of a medicament for the treatment and/or prevention of clinical conditions for which a selective action on 5-HT receptors is indicated.
- 15 8. Use of a compound as claimed in Claim-1 for the treatment and/or prevention of clinical conditions such as anxiety, depression, convulsive disorders, obsessive-compulsive disorders, migraine headache, cognitive memory disorders, ADHD (Attention Deficient Disorder/ Hyperactivity Syndrome), personality disorders, psychosis, paraphrenia,  
20 psychotic depression, mania, schizophrenia, schizophreniform disorders, withdrawal from drug abuse, panic attacks, sleep disorders and also disorders associated with spinal trauma and /or head injury.
9. Use of a compound as claimed in Claim-1 for the treatment of mild cognitive impairment  
25 and other neurodegenerative disorders like Alzheimer's disease, Parkinsonism and Huntington's chorea.
10. Use of a compound as claimed in Claim-1 for the treatment of certain GI  
(Gastrointestinal) disorders such as IBS (Irritable bowel syndrome) or chemotherapy  
30 induced emesis.
11. Use of a compound as claimed in Claim-1 to reduce morbidity and mortality associated with the excess weight.
- 35 12. Use of a radiolabelled compound as claimed in Claim-1, as a diagnostic tool for modulating 5-HT receptor function.

13. Use of a compound as claimed in Claims 1 in combination with a 5-HT re-uptake inhibitor, and / or a pharmaceutically acceptable salt thereof.
- 5 14. A compound of the general formula (1), its tautomeric forms, its stereoisomers, its polymorphs, its pharmaceutically acceptable salts and its pharmaceutically acceptable solvates for preparing a medicament.
- 10 15. A method for the treatment and/or prophylaxis of clinical conditions such as anxiety, convulsive disorders, obsessive-compulsive disorders, migraine headache, cognitive memory disorders, ADHD (Attention Deficient Disorder/ Hyperactivity Syndrome), personality disorders, psychosis, paraphrenia, psychotic depression, mania, schizophrenia, schizophreniform disorders, withdrawal from drug abuse, panic attacks, sleep disorders and also disorders associated with spinal trauma and /or head injury  
15 which comprises administering to a patient in need thereof, an effective amount of a compound of general formula (I) as claimed in Claim-1.
- 20 16. A method for the treatment and/or prophylaxis of mild cognitive impairment and other neurodegenerative disorders like Alzheimer's disease, Parkinsonism and Huntington's chorea which comprises administering to a patient in need thereof, an effective amount of a compound of general formula (I) as claimed in Claim-1.
- 25 17. A method for the treatment of certain GI (Gastrointestinal) disorders such as IBS (Irritable bowel syndrome) or chemotherapy induced emesis using a compound of general formula (I) as claimed in Claim-1.
- 30 18. A method to reduce morbidity and mortality associated with the excess weight using a compound of general formula (I) as claimed in Claim-1.
- 30 19. A process for the preparation of a compound of general formula (I), as defined in claim 1, which comprises of any one of the following routes,

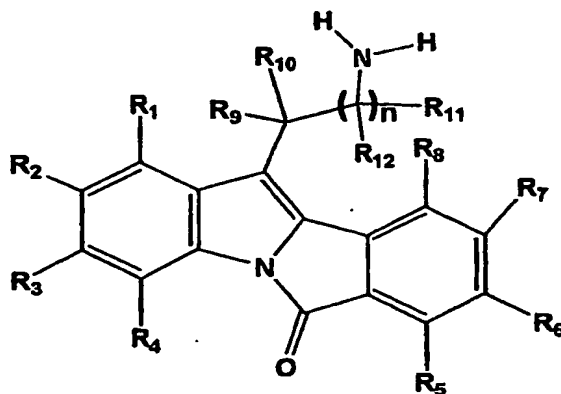
Route i): cyclizing a compound of formula (II) given below,



(II)

wherein X is halogen such chloro, bromo or iodo,  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ ,  $R_8$ ,  $R_9$ ,  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{13}$ ,  $R_{14}$  and "n", wherein all the symbols are as defined above, using a Pd(0) or Pd (II) derivative as a catalyst;

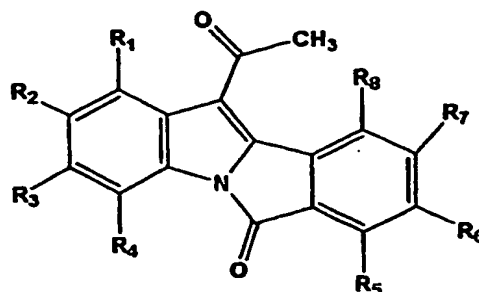
Route ii): reacting a compound (III) given below,



(III)

wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ ,  $R_8$ ,  $R_9$ ,  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$  and "n" are as defined above, with a suitable alkylating agent such as  $R_{13}X$  or  $R_{14}X$  or  $XR_{13}R_{14}X$  in successive steps or in one step, wherein X is good leaving group such as halogen and hydroxyl;

Route iii): reacting a compound of (IV) given below,



(IV)

wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  are as defined above, with formaldehyde and a compound of formula (V) given below,



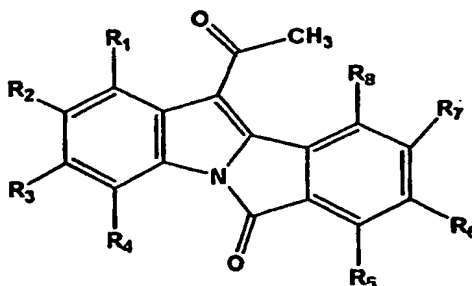
(V)

wherein  $R_{13}$  and  $R_{14}$  are as defined above

Route iv): either chemically or catalytically reducing compounds containing  $-\text{C}(=\text{O})$  group/s in the side chain, to the corresponding  $-\text{C}(\text{OH},\text{H})$  or  $-\text{C}(\text{H},\text{H})$  compound.

20. A process according to Claim-19 comprising of carrying out one or more of the following optional steps: i) removing any protecting group; ii) resolving the racemic mixture into pure enantiomers by the known methods and iii) preparing a pharmaceutically acceptable salt of a compound of formula (I) and/or iv) preparing a pharmaceutically acceptable prodrug thereof.

21. Novel intermediates defined of general formula (IV),



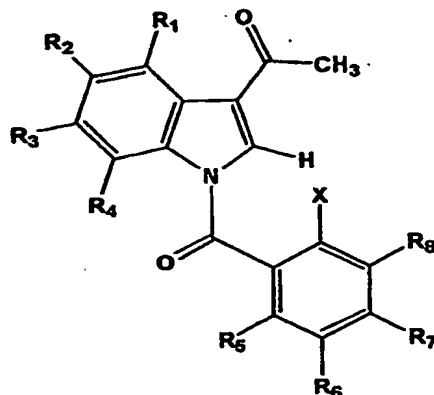
(IV)

wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  are as may be same or different and each independently represent hydrogen, halogen, perhaloalkyl, substituted or unsubstituted

groups such as linear or branched (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>3</sub>-C<sub>7</sub>)cycloalkyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, cyclo(C<sub>3</sub>-C<sub>7</sub>)alkoxy, aryl, aryloxy, aralkyl, aralkoxy, heterocyclyl, acyl, acyloxy, acylamino, monoalkylamino, dialkylamino, hydroxyalkyl, alkoxyalkyl, aryloxyalkyl, aralkoxyalkyl, alkylthio, sulfonic acids and its derivatives.

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22. A process provided for the preparation of novel intermediate of the general formula (IV) which comprises of cyclizing compounds of formula (VIII)



(VIII)

wherein, R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub> and R<sub>8</sub> are as defined above; X is halogeno such as chloro, bromo or iodo, using a Pd(0) or Pd (II) derivative as a catalyst.

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